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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/900,992	07/09/2001	Naoya Hasegawa	9281-3995	6893

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EXAMINER	
MAGEE, CHRISTOPHER R	

ART UNIT	PAPER NUMBER
2653	

DATE MAILED: 09/12/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/900,992	HASEGAWA ET AL.
	Examiner	Art Unit
	Christopher R. Magee	2653

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 21 June 2005.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-16 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-16 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment after Non-Final Office Action

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> *A person shall be entitled to a patent unless –*
>
> *(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.*

1. Claims 1, 2 and 9-16 are rejected under 35 U.S.C. 102(b) as being anticipated by Hasegawa et al. (hereinafter Hasegawa '647) (JPO English machine translation of JP 11-191647, publication date 7/13/1999).

- Regarding claims 1 and 12, Hasegawa '647 discloses an exchange coupling film comprising an antiferromagnetic layer [4] and a ferromagnetic layer [3], which are formed in contact with each other so that the magnetization direction of the ferromagnetic layer is pinned in a predetermined direction by an exchange coupling magnetic field produced at the interface between both layers, wherein the antiferromagnetic layer is made of an antiferromagnetic material comprising an element X (at least one element selected from Pt, Pd, Ir, Rh, Ru, and Os) and Mn; [Hasegawa English translation, section 0017] and

  in a section of the exchange coupling film in parallel with the thickness direction thereof, the crystal grain boundaries formed in the antiferromagnetic layer and the crystal grain boundaries formed in the ferromagnetic layer are discontinuous in at least a portion of the interface [Hasegawa English translation, section 0017].

- Regarding claim 2, Hasegawa '647 discloses the antiferromagnetic layer and the ferromagnetic layer, equivalent crystal planes represented by a (111) plane are preferentially oriented in parallel with the interface [Hasegawa English translation, sections 0019 to 0021].

- Regarding claim 9, Hasegawa '647 teaches the antiferromagnetic layer is made of a X-Mn-X' alloy (wherein X' represents at least one element selected from Ne, Ar, Kr, Xe, Be, B, C, N, Mg, Al, Si, P, Ti, V, Cr, Fe, Co, Ni, Cu, Zn, Ga, Ge, Zr, Nb, Mo, Ag, Cd, Ir, Sn, Hf, Ta, W, Re, Au, Pb, and the rare earth elements) [Hasegawa English translation, sections 0023 and 0024].

- Regarding claim 10, Hasegawa '647 teaches the X-Mn-X' alloy is an interstitial solid solution in which the element X' enters the interstices between space lattices composed of the element X and Mn. or a substitution solid solution in which the lattice points of crystal lattices composed of the element X and Mn are partially substituted by the element X' [Hasegawa English translation, sections 0023 and 0024].

- Regarding claim 11, Hasegawa '647 teaches the composition ratio of the element X or elements (X + X') is 45 at% to 60 at% [Hasegawa English translation, sections 00111 and 0112].

- Regarding claim 13, Hasegawa '647 discloses a magnetoresistive element comprising an antiferromagnetic layer [4], a pinned magnetic layer [3] formed in contact with the antiferromagnetic layer so that the magnetization direction is pinned by an exchange coupling magnetic field with the antiferromagnetic layer, a free magnetic layer [1]formed on the pinned magnetic layer with a nonmagnetic intermediate layer [2] provided there between, and a bias layer [5] for orienting the magnetization direction of the free magnetic layer in a direction crossing the magnetization direction of the pinned magnetic layer, wherein the antiferromagnetic layer and the pinned magnetic layer formed in contact with the antiferromagnetic layer comprise

an exchange coupling film according to Claim 1 [Hasegawa English translation, section 0033, drawing 1].

- Regarding claim 14, Hasegawa '647 discloses a magnetoresistive element comprising an antiferromagnetic layer [4], a pinned magnetic layer [3] formed in contact with the antiferromagnetic layer so that the magnetization direction is pinned by an exchange coupling magnetic field with the antiferromagnetic layer, a free magnetic layer [1] formed on the pinned magnetic layer with a nonmagnetic intermediate layer [2] provided there between, and antiferromagnetic exchange bias layers [9] formed on or below the free magnetic layer with a space corresponding to a track width Tw, wherein the exchange bias layers and the free magnetic layer comprise an exchange coupling film according to Claim 1, and magnetization of the free magnetic layer is pinned in a predetermined direction [Hasegawa English translation, section 0034, drawing 2].

- Regarding claim 15, Hasegawa '647 discloses a magnetoresistive element comprising nonmagnetic layers laminated on and below a free magnetic layer [1], pinned magnetic layers [3] located on one of the nonmagnetic intermediate layers [2] and below the other nonmagnetic intermediate layer, antiferromagnetic layers [4] located on one of the pinned magnetic layers and below the other pinned magnetic layer, for pinning the magnetization direction of each of the pinned magnetic layers in a predetermined direction by an exchange coupling magnetic field, and a bias layer [5] for orienting the magnetization direction of the free magnetic layer in a direction crossing the magnetization direction of the pinned magnetic layers, wherein the antiferromagnetic layers and the pinned respectively formed in contact with the

antiferromagnetic layers comprise an exchange coupling film according to Claim 1 [Hasegawa English translation, section 0035, drawing 3].

- Regarding claim 16, Hasegawa '647 discloses a magnetoresistive element comprising magnetoresistive layer [12] and a soft magnetic layer [10] which are laminated with a nonmagnetic layer [11] provided there between, and antiferromagnetic layers formed on or below the magnetoresistive layer with a space there between corresponding to a track width Tw, wherein the antiferromagnetic layers and the magnetoresistive layer comprise an exchange coupling film according to Claim 1 [Hasegawa English translation, section 0036, drawing 4].

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 3 and 8 are rejected under 35 U.S.C. 103(a) as being obvious over Hasegawa et al. (hereinafter Hasegawa '647) (JPO English machine translation of JP 11-191647, publication date 7/13/1999) as applied to claim 1 above and further in view of Gill (US 6,456,469 B1).

- Regarding claims 3 and 8, Hasegawa '647 discloses all the features, *supra*, but does not teach a seed layer formed below the ferromagnetic layer and having a crystal structure mainly composed of a face-centered cubic crystal in which equivalent crystal planes represented by the {111} plane are preferentially oriented in parallel with the interface.

Gill teaches a seed layer [408] formed below a pinned layer [416] and in contact with an antiferromagnetic layer [410], and having a crystal structure mainly composed of a face-centered cubic crystal in which equivalent crystal planes represented by the {111} plane are preferentially oriented in parallel with the interface [col. 6, line 65 to col. 7, line 11; col. 10, lines 64-67].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to provide the magnetoresistive element of Hasegawa with a seed layer formed below the ferromagnetic layer and having a crystal structure of a face-centered cubic crystal as taught by Gill.

The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to provide the magnetoresistive element of Hasegawa with a seed layer formed below the ferromagnetic layer and having a crystal structure of a face-centered cubic crystal as taught by Gill in order to establish a consistent crystalline structure for adjacent layers [Gill; col. 6, lines 25-40].

3. Claims 4-7 are rejected under 35 U.S.C. 103(a) as being obvious over Hasegawa et al. (hereinafter Hasegawa '647) (JPO English machine translation of JP 11-191647, publication date 7/13/1999) and Gill (US 6,456,469 B1) as applied to claim 3 above and further in view of Lee et al. (hereinafter Lee) (US 5,731,936).

- Regarding claim 4, Hasegawa '647 and Gill disclose all the features, *supra*, but do not teach the seed layer is made of a NiFe alloy, Ni, a Ni-Fe-Y alloy (wherein Y is at least on element selected from Cr, Rh, Ta, Hf, Nb, Zr, and Ti) or a Ni-Y alloy.

Lee teaches a seed layer [74] composed of a Ni-Fe-Y alloy (wherein Y is at least on element selected from Cr, Rh, Ta, Hf, Nb, Zr, and Ti) [col. 2, lines 45-63].

Regarding claim 5, Lee teaches the seed layer is represented by the composition formula $(Ni_{1-x}Fe_x)_{1-y}\ Y_y$ (x and y are atomic ratios) wherein the atomic ratio x is 0 to 0.3, and the atomic ratio y is 0 to 0.5 [col. 6, lines 15-24].

Regarding claim 6, Lee discloses the seed layer is nonmagnetic at normal temperature [col. 6, lines 47-55].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to provide the magnetoresistive element of Hasegawa and Gill with a seed layer composition as taught by Lee.

The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to provide the magnetoresistive element of Hasegawa and Gill with a seed layer composition as taught by Lee in order to increase the MR coefficient [Lee; col. 2, lines 45-48].

- Regarding claim 7, Hasegawa '647 and Gill disclose all the features, *supra*, but do not teach an underlayer formed below the seed layer and comprising at least one element selected from Ta, Hf, Nb, Zr, Ti, Mo and W.

Lee discloses an underlayer formed below the seed layer and comprising at least one element selected from Ta, Hf, Nb, Zr, Ti, Mo and W [col. 2, lines 51-54].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to provide the magnetoresistive element of Hasegawa and Gill with an underlayer formed below the seed layer as taught by Lee.

The rationale is as follows: One of ordinary skill in the art at the time of the invention would have been motivated to provide the magnetoresistive element of Hasegawa and Gill with an underlayer formed below the seed layer as taught by Lee in order to increase the MR coefficient of the magnetoresistive element [Lee; col. 2, lines 51-54].

Response to Arguments

4. Applicant's arguments filed 06/21/2005 have been fully considered but they are not persuasive.

The Applicant asserts on page 9 of the REMARKS:

> *"The Office action cites section [0017] of the machine translation of Hasegawa '647 as the source of the disclosure that allegedly anticipates independent claim 1. Applicants include herewith as Appendix A an English translation of section (0017) of Hasegawa '647. It is clear from the translation of section [0017] that Hasegawa '647 does not disclose the limitations of claim 1. In particular, claim 1 recites an exchange coupling film with a ferromagnetic layer and an antiferromagnetic layer and that, 'in a section of the exchange coupling film in parallel with the thickness direction thereof, the crystal grain boundaries formed in the antiferromagnetic layer and the crystal grain boundaries formed in the ferromagnetic layer are discontinuous in at least a portion of the interface.' (Emphasis added.) Hasegawa '647 does not disclose such an arrangement. Specifically, Hasegawa '647 makes no reference to grain boundaries in the exchange coupling film nor to any discontinuity between them. Applicants also point out that the machine translation cited by the Office action includes no mention of grain boundaries.*
>
> *Since Hasegawa '647 does not disclose each and every element of independent claim 1, the reference cannot anticipate the pending claims. Applicants therefore respectfully request that the rejection of claims 1, 2 and 9-16 under 35 U.S.C. 102(b) be withdrawn."*

The Examiner maintains that Hasegawa '647 discloses "in a section of the exchange coupling film in parallel with the thickness direction thereof, the crystal grain boundaries formed in the antiferromagnetic layer and the crystal grain boundaries formed in the ferromagnetic layer are discontinuous in at least a portion of the interface" [Hasegawa English translation, section

0017]. The English translation provided by Applicant states "the structure of the interface between the antiferromagnetic layer and ferromagnetic layer is a disorder state." The structure of the interface between the antiferromagnetic layer and ferromagnetic layer includes the crystal grain boundaries, which are in a discontinuous state. It is inherent that the interface structure between the antiferromagnetic layer and the ferromagnetic layer includes crystal grain boundaries. In section 0018 of Hasegawa '647, it is desirable that the crystal orientation of the antiferromagnetic layer and the ferromagnetic layer have an interface disordered state. The limitations of claims 1, 2 and 9-16 have been met and the rejection is upheld.

As previously mentioned, Hasegawa '647 discloses the limitation of claims 1, 2 and 9-16 and therefore the rejection of claims 3-8 is maintained.

Conclusion

5. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christopher R. Magee whose telephone number is (571) 272-7592. The examiner can normally be reached on M-F, 8: 00 am-5: 30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, William Korzuch can be reached on (571) 272-7589. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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September 1, 2005
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